1. A phosphorus-containing flame-retardant hardener having a formula selecting from the group consisting of (A) to (I):

$$(Q)_{i}$$
 $(Q)_{m}$
 $(Q)_{i}$
 $(Q)_$

$$(Q)_{i}(H)_{2\cdot i}N \longrightarrow (Q)_{i}(H)_{2\cdot i}N - C = N - C \equiv N$$

$$(Q)_{i}(H)_{2\cdot i}N - C = N - C \equiv N$$

$$(Q)_{i}(H)_{2\cdot i}N - C = N - C \equiv N$$

$$(D)$$

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$$Z$$

$$N N N (H)_{2\cdot j}(Q')_{i}$$

$$(Q')_{i}(H)_{2\cdot i}N - C = N - C = N$$

$$(Q')_{i}(H)_{2\cdot i}N - (Q')_{i}(H)_{2\cdot i}N - (Q')_{i}N - (Q$$

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I and m independently are 0, 1 or 2, and I + m > 0; i and j independently are 0, 1 or 2, and 0 < i + j < 4; k is 0 or 1, and i + k < 3;

Z is $-NH_2$, $-CH_3$ or phenyl;

5 X

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Q:
$$\begin{array}{c|c} & Ar & Ar \\ \hline O & O & P \\ \hline R1 & R2 & R1 & R2 \\ \end{array}$$

Q':

15 wherein

R¹, R² independently are H, C1~C18 alkyl, C6~C18 aryl, C6~C18 substituted aryl, C6~C18 aryl methylene, or C6~C18 substituted aryl methylene;

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$$Ar =$$
 $(R)n$ or $(R)n$

wherein R is C1-C4 alkyl or C6-C18 aryl; and n is an integer of 0 to 5.

2. The hardener according to claim 1, wherein the hardener has the

formula (A).

3. The hardener according to claim 1, wherein the hardener has the formula (B).

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- 4. The hardener according to claim 1, wherein the hardener has the formula (C).
- 5. The hardener according to claim 1, wherein the hardener has the10 formula (D).
 - 6. The hardener according to claim 1, wherein the hardener has the formula (E) or (F).
- 7. The hardener according to claim 1, wherein the hardener has formula (G).
 - 8. The hardener according to claim 1, wherein the hardener has the formula (H) or (I).

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9. The hardener according to claim 1, wherein i and j are 0 or 1, when the hardener has a formula selected from the group consisting of (B), (C), (D), (G) and (H).

- 10. The hardener according to claim 8, wherein k is 0, when the hardener has the formula (I).
 - 11. The hardener according to claim 4, wherein Z is -NH₂.

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- 12. The hardener according to claim 7, wherein Z is $-NH_2$.
- 13. The hardener according to claim 2, wherein R^1 and R^2 are hydrogen, and n is 0.

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- 14. The hardener according to claim 3, wherein R¹ and R² are hydrogen, and n is 0.
- 15. The hardener according to claim 4, wherein R¹ and R² are 15 hydrogen, and n is 0.
 - 16. The hardener according to claim 5, wherein R^1 and R^2 are hydrogen, and n is 0.
- 20 17. The hardener according to claim 13, wherein Ar is phenoxy.
 - 18. The hardener according to claim 14, wherein Ar is phenoxy.
 - 19. The hardener according to claim 15, wherein Ar is phenoxy.

- 21. The hardener according to claim 6, wherein Ar is phenyl.
- 5 22. The hardener according to claim 7, wherein Ar is phenyl.
 - 23. The hardener according to claim 8, wherein Ar is phenyl.
 - 24. The hardener according to claim 2, wherein X is

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25. The hardener according to claim 3, wherein X is -CH₂- or

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26. A phosphorus-containing frame-retardant advanced epoxy resin and cured epoxy resin having the following formula (J):

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wherein

$$0 < h < 10$$
;

T = L or M, wherein

the formula (J) represents the advanced epoxy resin, when T = L; and the formula (J) represents the cured epoxy resin, when T = M;

A' is

5

wherein I and m are independently are 0, 1 or 2, and I + m > 0;

10 X

15

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25 wherein

R¹, R² independently are H, C1~C18 alkyl, C6~C18 aryl, C6~C18 substituted aryl, C6~C18 aryl methylene, or C6~C18 substituted aryl methylene;

$$Ar =$$
 $(R)n$ $(R)n$ $(R)n$

wherein R is C1-C4 alkyl or C6-C18 aryl; and n is an integer of 0 to 5;

5 Ep is

$$Y = -CH_{\frac{1}{2}}, -CH_{\frac{1}{3}}, -O-, -S-_{or}-S-_{or}$$

or a phenol-aldehyde novolac epoxy resin backbone, and when Ep is the phenol-aldehyde novolac epoxy resin backbone, the flame-retardant advanced epoxy resin and the cured epoxy resin represented by the formula (J) is prepared by reacting a phosphorus-containing flame-retardant hardener having the following formula (A) with a phenol-aldehyde novolac epoxy resin having the following

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formula (II)

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$$(Q)_{i}$$
 $(Q)_{m}$
 $(Q)_{m}$
 (A)

wherein Q, X, I and m are defined as above;

OCH₂CH-CH₂ OCH₂CH-CH₂ OCH₂CH-CH₂ $CH_2 \qquad CH_2 \qquad CH_2 \qquad G$ $R^3 \qquad CH_2 \qquad CH_2 \qquad G$ $R^3 \qquad CH_2 \qquad CH_2 \qquad G$ $R^3 \qquad G$ $R^3 \qquad G$ $CH_2 \qquad G$ $R^3 \qquad G$ $R^3 \qquad G$ $CH_2 \qquad G$ $R^3 \qquad G$ $R^3 \qquad G$ $R^3 \qquad G$

wherein R³ is hydrogen, or -CH₃, and g is an integer of 1-6.

- 27. The phosphorus-containing frame-retardant advanced epoxy resin and cured epoxy resin according to claim 26, wherein Ep in the formula (J)
- 5 is

$$-$$
 , wherein Y is $-C(CH_3)_2$ -.

- 28. The phosphorus-containing frame-retardant advanced epoxy resin and cured epoxy resin according to claim 26, wherein Ep in the formula (J) is the phenol-aldehyde novolac epoxy resin backbone, wherein R³ in the phenol-aldehyde novolac epoxy resin (II) is -CH₃.
- 29. The phosphorus-containing frame-retardant advanced epoxy resinand cured epoxy resinaccording to claim 26, wherein R¹ and R² are hydrogen, and n is 0.
 - 30. The phosphorus-containing frame-retardant advanced epoxy resin and cured epoxy resin according to claim 26, wherein X is

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31. A flame-retardant epoxy resin having a formula selected from the group consisting of (EP-A) to (EP-I):

$$L'O \xrightarrow{(Q)_i} X \xrightarrow{(Q)_m} OL' \qquad (Q)_i(L')_{2\cdot i}N \xrightarrow{X} N(L')_{2\cdot j}(Q)$$

$$(EP-A) \qquad (EP-B)$$

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$$(Q)_{i}(L')_{2-i}N \xrightarrow{N} N(L')_{2-j}(Q)_{j} , \qquad (Q)_{i}(L')_{2-i}N-C=N-C\equiv N$$

$$(EP-D)$$

15

$$(Q')_{i}(L')_{2-i}N \xrightarrow{N} N(L')_{2-j}(Q')_{i} , \qquad (Q')_{i}(L')_{2-i}N-C=N-C\equiv N$$

$$(EP-G) \qquad (EP-H)$$

20

$$NQ'$$
 $(Q')_{i}(L')_{2-i}N-C-N(L')_{1-k}(Q')_{k}-C\equiv N$
(EP-I)

wherein I, m, i, j, k, Z, X, Q and Q' are defined as in claim 1; and L' is

hydrogen or

, provided that at least two L' are L in each

formula.

- 5 32. The flame-retardant epoxy resin according to claim 31, wherein the flame retardant epoxy resin has the formula (EP-A).
 - 33. The flame-retardant epoxy resin according to claim 31, wherein the flame retardant epoxy resin has the formula (EP-B).

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- 34. The frame-retardant epoxy resin according to claim 32, wherein R¹ and R² are hydrogen, and n is 0.
- 35. The frame-retardant epoxy resin according to claim 33, wherein R¹ and R² are hydrogen, and n is 0.
 - 36. The frame-retardant epoxy resin according to claim 34, wherein X is

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37. The frame-retardant epoxy resin according to claim 35, wherein X is $-CH_2$ - or